

What Is Claimed Is:

- 1 1. A method for I/Q mismatch calibration of a receiver
2 having an I/Q correction module which performs
3 $x_o[n] = A_p \cdot x_i[n] + B_p \cdot x_i^*[n]$ where $x_i[n]$ and $x_o[n]$ respectively
4 represent the input and output signal of the I/Q correction
5 module, the superscript * refers to a complex conjugate, and A_p
6 and B_p are correction parameters, comprising the following
7 steps:
8 generating a test signal $x(t)$ containing a single tone
9 waveform with frequency of $(f_c + f_T)$ Hz , where f_c and
10 f_T are real numbers;
11 applying I/Q demodulation to reduce the central frequency
12 of the test signal $x(t)$ by f_c Hz and output a
13 demodulated signal $x_{dem}(t)$;
14 converting the demodulated signal $x_{dem}(t)$ to a digital
15 signal $x_{dem}[n]$;
16 obtaining measures U_1 and U_2 of the digital signal $x_{dem}[n]$
17 where U_1 and U_2 are values indicative of the frequency
18 response of $x_{dem}(t)$ at frequency $+f_T$ Hz and $-f_T$ Hz ,
19 respectively; and
20 calculating the set of the correction parameters A_p and B_p
21 for the I/Q correction module based on the measures
22 U_1 and U_2 .

1 2. The method for I/Q mismatch calibration of a receiver
2 as claimed in claim 1, the measure U_1 and U_2 are obtained from
3 the coefficients of the Fourier transformation of the $x_{dem}[n]$
4 corresponding to the frequency $+f_T$ Hz and $-f_T$ Hz.

1 3. The method for I/Q mismatch calibration of a receiver
2 as claimed in claim 1, wherein the test signal
3 $x(t)=\cos(2\pi(f_c+f_T))$.

1 4. The method for I/Q mismatch calibration of a receiver
2 as claimed in claim 1, wherein the set of correction parameters
3 (A_p, B_p) are obtained by

$$\begin{cases} A_p = R + j\alpha S \\ B_p = -\alpha R - jS \end{cases}$$

5 where α , R , and S are obtained based on U_1 and U_2 .

1 5. The method for I/Q mismatch calibration of a receiver
2 as claimed in claim 4, wherein α , R , and S are obtained based
3 on

$$H = \text{real}(U_1 \cdot U_2) ,$$

$$I = \text{imag}(U_1 \cdot U_2) ,$$

6 and

$$G = |U_1|^2 + |U_2|^2 .$$

1 6. The method for I/Q mismatch calibration of a receiver
2 as claimed in claim 4.1, wherein α , R , and S are obtained by

$$\alpha = \frac{H}{\kappa} ,$$

4 where

$$\kappa = \frac{G + \sqrt{G^2 - 4H^2}}{2} ,$$

6 and

$$R = \sqrt{\frac{1+P}{2}},$$

$$S = \sqrt{\frac{Q}{2 \cdot \sqrt{\frac{1+P}{2}}}},$$

where

$$Q = \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)},$$

$$P = \sqrt{1 - \left(\frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} \right)^2}.$$

7. The method for I/Q mismatch calibration of a receiver as claimed in claim 4, wherein the set of correction parameters (A_p, B_p) is further normalized such that the power of the output signal of the I/Q correction module equals to that of the input signal of the I/Q correction module.

8. An apparatus for I/Q mismatch calibration of a receiver having an I/Q correction module which performs $x_o[n] = A_p \cdot x_i[n] + B_p \cdot x_i^*[n]$ where $x_i[n]$ and $x_o[n]$ respectively represent the input and output signal of the I/Q correction module, the superscript * refers to a complex conjugate, and A_p and B_p are correction parameters, comprising:

a signal generator for generating a test signal $x(t)$ which contains a single tone waveform with frequency of $(f_c + f_T)$ Hz, where f_c and f_T are real numbers;

a demodulator for applying I/Q demodulation to reduce the central frequency of the test signal $x(t)$ by f_c Hz and outputting a demodulated signal $x_{dem}(t)$;

13 A/D converters for converting the demodulated signal $x_{dem}(t)$
14 to a digital signal $x_{dem}[n]$;
15 a dual-tone correlator for obtaining measures U_1 and U_2 of
16 the digital signal $x_{dem}[n]$ output from the I/Q
17 correction module where U_1 and U_2 are values
18 indicative of the frequency response of $x_{dem}(t)$ at
19 frequency $+f_T$ Hz and $-f_T$ Hz, respectively; and
20 a processor for obtaining the set of the correction
21 parameters A_p and B_p according to the measures U_1 and
22 U_2 .

1 9. The apparatus for I/Q mismatch calibration of a
2 receiver as claimed in claim 8, the measure U_1 and U_2 are obtained
3 from the coefficients of the Fourier transformation of the
4 $x_{dem}[n]$ corresponding to the frequency $+f_T$ Hz and $-f_T$ Hz.

1 10. The apparatus for I/Q mismatch calibration of a
2 receiver as claimed in claim 8, wherein the test signal
3 $x(t) = \cos(2\pi(f_c + f_T)t)$.

1 11. The apparatus for I/Q mismatch calibration of a
2 receiver as claimed in claim 8, wherein the set of correction
3 parameters (A_p, B_p) are obtained by

$$4 \quad \begin{cases} A_p = R + j\alpha S \\ B_p = -\alpha R - jS \end{cases}$$

5 where α , R , and S are obtained based on U_1 and U_2 .

1 12. The apparatus for I/Q mismatch calibration of a
2 receiver as claimed in claim 11, wherein α , R , and S are obtained
3 based on

$$4 \quad H = \text{real}(U_1 \cdot U_2^*),$$

5
$$I = \text{imag}(U_1 \cdot U_2) ,$$

6 and

7
$$G = |U_1|^2 + |U_2|^2 .$$

1 13. The apparatus for I/Q mismatch calibration of a
2 receiver as claimed in claim 12, wherein α , R , and S are obtained
3 by

4
$$\alpha = \frac{H}{\kappa} ,$$

5 where

6
$$\kappa = \frac{G + \sqrt{G^2 - 4H^2}}{2} ,$$

7 and

8
$$R = \sqrt{\frac{1+P}{2}} ,$$

9
$$S = \sqrt{\frac{Q}{2 \cdot \sqrt{\frac{1+P}{2}}}} ,$$

10 where

11
$$Q = \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} ,$$

12
$$P = \sqrt{1 - \left(\frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} \right)^2} .$$

1 14. The apparatus for I/Q mismatch calibration of a
2 receiver as claimed in claim 11, wherein the set of correction
3 parameters (A_p, B_p) is further normalized such that the power of
4 the output signal of the I/Q correction module equals to that
5 of the input signal of the I/Q correction module.